

Debridement, Drainage and Biofilm Management

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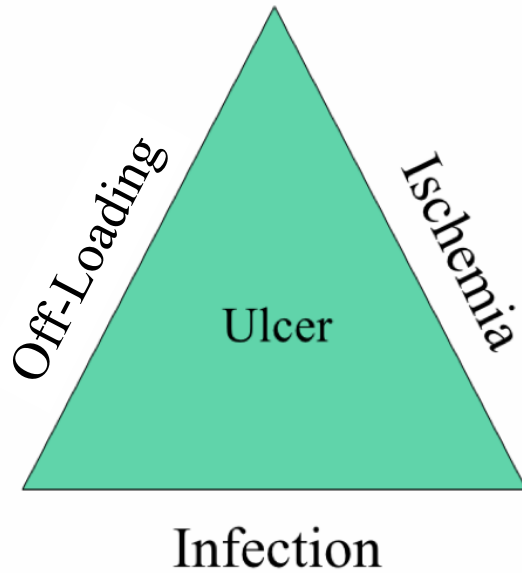
Copenhagen Wound Healing Center

Bispebjerg University Hospital

Disclosure

- For this lecture:
 - None
- In general:
 - Advisory board SoftOx, Mölnlycke, Bayer Pharma, Magle Chemoswed
 - Lecture Coloplast
 - Patent Acetic acid against Biofilm

Treatment Protocol



Infection

- In terms of:
 - Impact of microorganisms



Ubi Pus, Ibi Evacua



- where [there is] pus, there evacuate [it]
- But
- Ubi pus, necrosis est
(Google translate)
- where [there is] pus, there is necrosis

Definition

- Debridement
 - Removal of dead, damaged or infected tissue.

Wikipedia



No drainage without debridement

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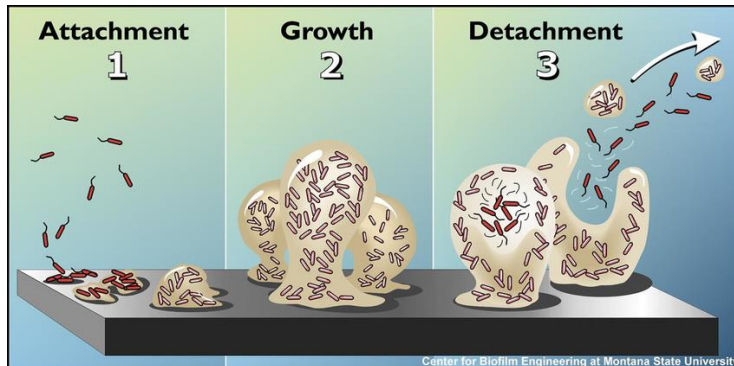
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Definition

- Biofilm

DEFINITION

Biofilms are defined as matrix-enclosed bacterial populations adherent to each other and/or to surfaces or interfaces. This definition includes microbial aggregates and flocs and also adherent populations within the pore spaces of porous media.



Costerton and Lewandowski, 1995

Biofilm in Diabetic Foot Ulcers

IWJ International Wound Journal

International Wound Journal ISSN 1742-4801

ORIGINAL ARTICLE

Microscopy visualisation confirms multi-species biofilms are ubiquitous in diabetic foot ulcers

Khalid Johani^{1,2}, Matthew Malone^{3,4,6}, Slade Jensen^{3,7}, Iain Gosbell^{3,7}, Hugh Dickson^{4,5,8}, Honhua Hu¹ & Karen Vickery¹

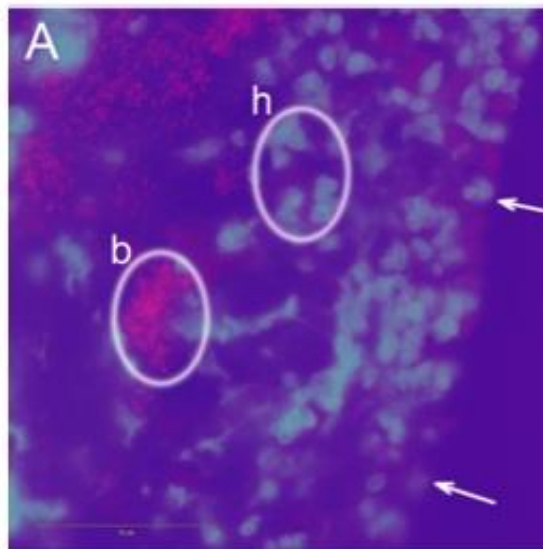


2017

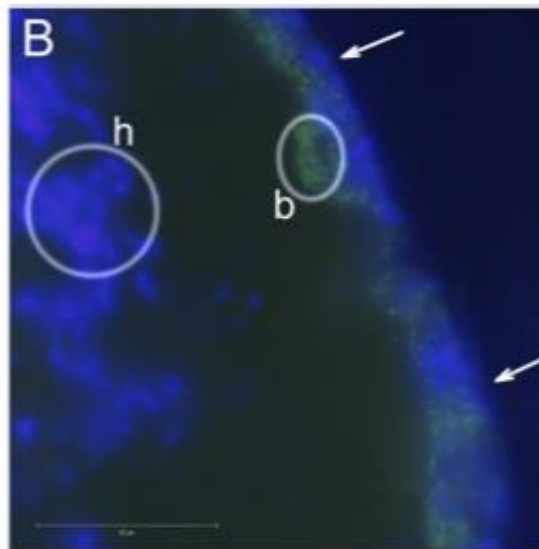
Controversies

- Normal bacterial biofilm is associated with surfaces
 - Implants
 - Katheters
- This has led to the assumption that bacterial biofilm is on the surface of chronic wounds

Distance from Surface



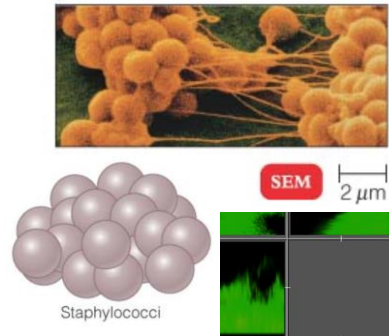
0-10 10-20 20-30 30-40 40-50 50-60 60-70
Distance to wound surface (μm)



Nonrandom Distribution of *Pseudomonas aeruginosa* and
Staphylococcus aureus in Chronic Wounds
Mustafa Fazli et al. JCM dec. 2009

Biofilm Size

- No Mushroom structure



Højbye et al. ESCMID* guideline for the diagnosis and treatment of biofilm infections 2014

Biofilm demonstrated in	Visualization method	Approximate diameter	Reference
Lung infections (CF)	Light microscopy	~4–8 μm	[197]
	Light microscopy	~5–100 μm	[198]
	FISH	~5–100 μm	[8]
Chronic wounds	FISH	~5–50 μm	[199]
	FISH	~5–200 μm	[40]
	FISH	~5–100 μm	[9]
	Light and electron microscopy	~35–55 μm	[39]
Soft tissue fillers	FISH	~5–25 μm	[20]
Otitis media	FISH	~15–25 μm	[200]
	FISH	~10–80 μm	[201]
	FISH	~4–40 μm	[202]
Implant-associated	Electron microscopy	~500 μm	[203]
	FISH	~50 μm	[204]
	Electron microscopy	~5–15 μm	[205]
Catheter- and shunt-associated	FISH	~5–30 μm	[206]
	Electron microscopy	~5–1000 μm	[207]
	Electron microscopy	~20–500 μm	[208]
	Fluorescence microscopy	~20–1200 μm	[209]
	FISH and electron microscopy	>1000 μm	[210]
Chronic osteomyelitis	Electron microscopy	~25 μm	[211]
	Electron microscopy	~25 μm	[212]
	Light and electron microscopy	~5–50 μm	[213]
Chronic rhinosinusitis	Electron microscopy	~5–30 μm	[214]
	Fluorescence microscopy	~5–20 μm	[215]
Contact lenses	Electron microscopy	~50–100 μm	[216]

Abbreviations: CF, cystic fibrosis; FISH, fluorescence *in situ* hybridization.

*The biofilm aggregate size was estimated by measuring the longest diameter or length directly on the micrograph images in the source articles. (adapted from ref. [11])

Tolerance and Resistance

Tolerance

- Phenotype
 - Dormant cells
- Quorum Sensing
 - Biofilm mode
- Diffusion

Resistance

- Genetic transferred mechanism
 - Beta-lactamases
 - ESBL
 - Plasmid mediated
 - MRSA
 - Change in Penicillin binding proteins
 - Other AB
 - Change in target enzymes or receptors

100-1000 more tolerant in biofilm!

Elimination is the New Black

- MBIC
 - Minimal Biofilm Inhibitory Concentration
- MBEC
 - Minimal Biofilm Elimination Concentration

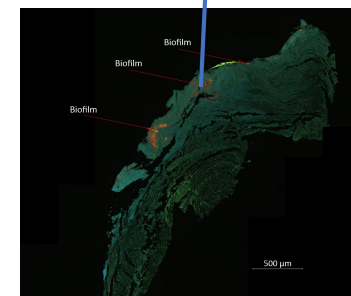
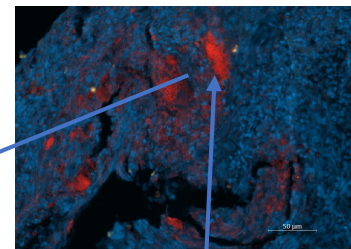
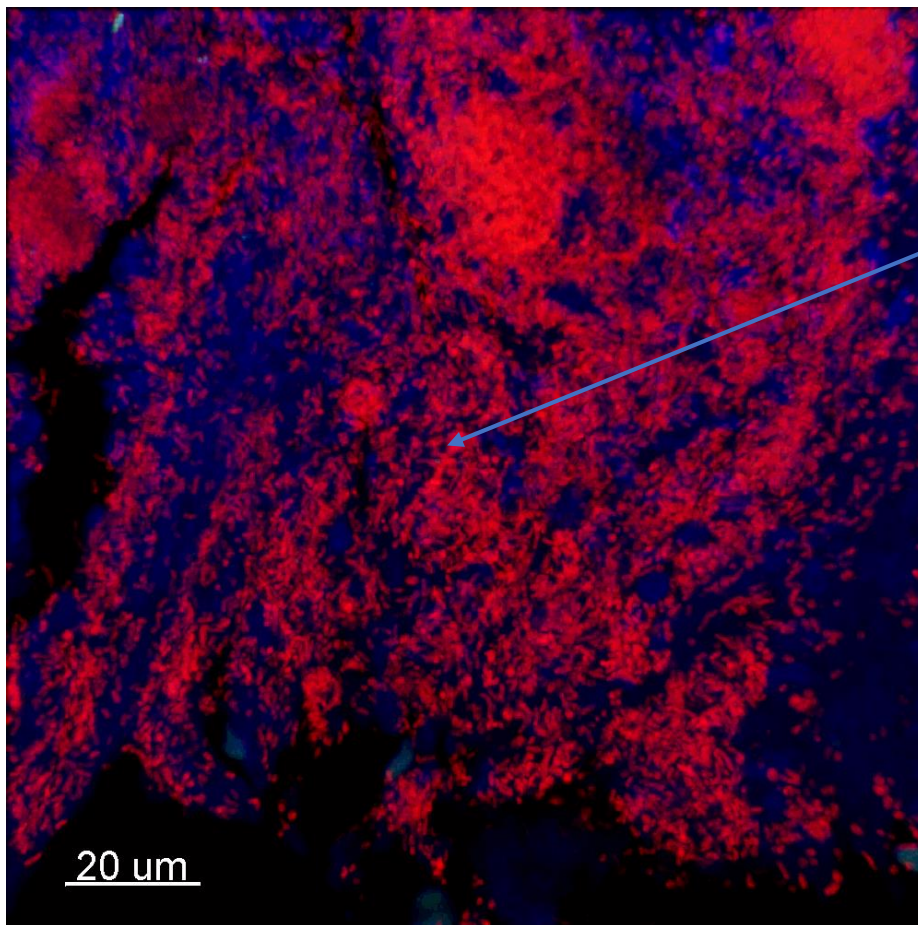


But does it make sense?

Bacteria Exists in Biofilm!

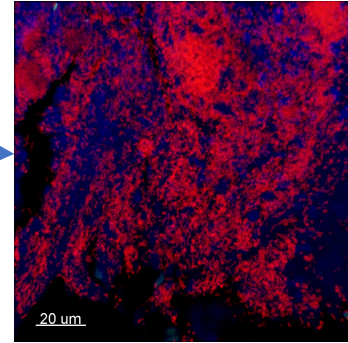
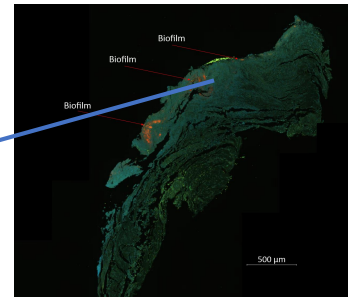
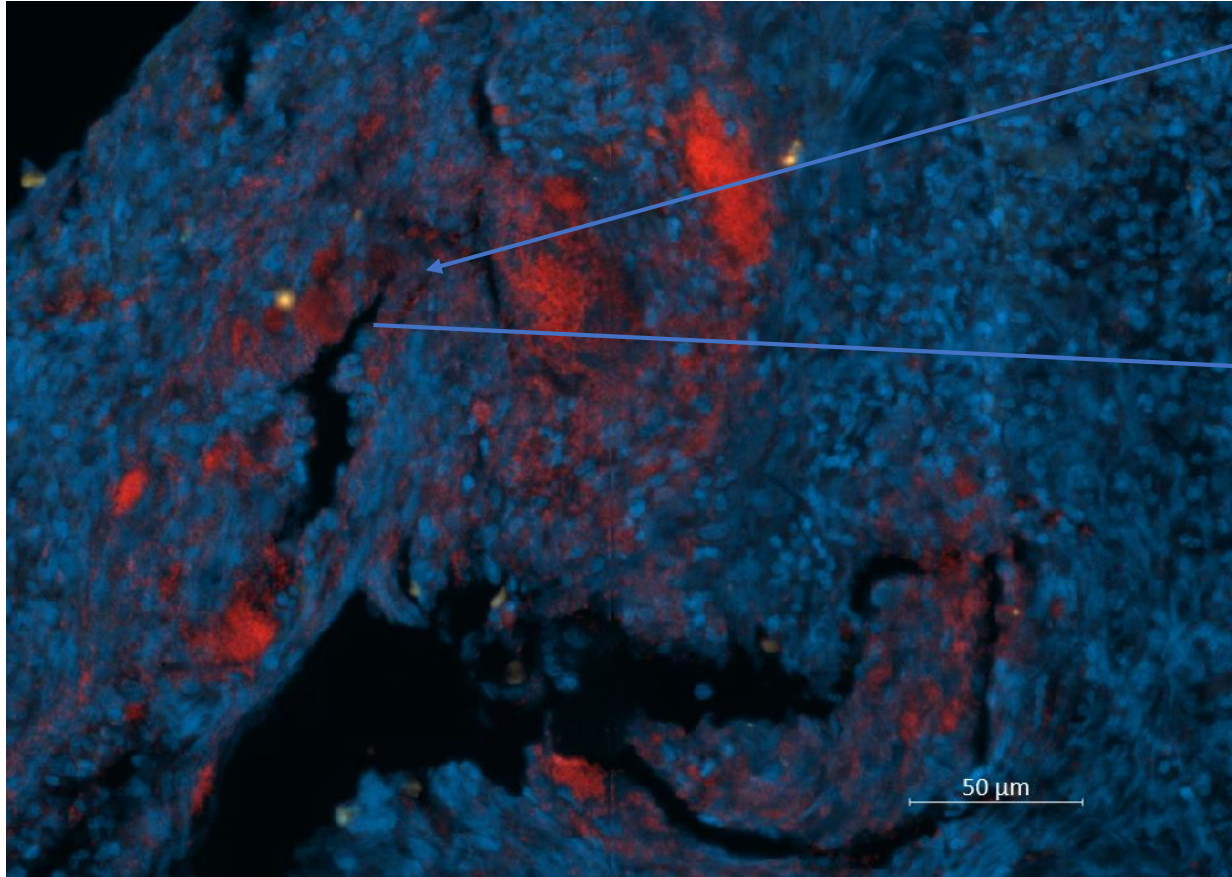
- Bacteria in biofilm are tolerant to antibiotics
- Bacteria in biofilm can interfere with the immune system
- Bacterial biofilms are abundant

Yet, Where are the Biofilms?



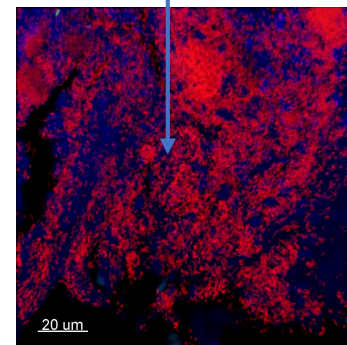
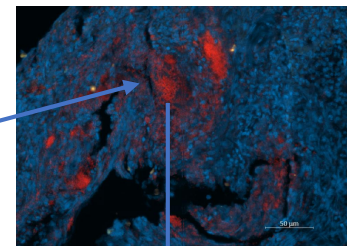
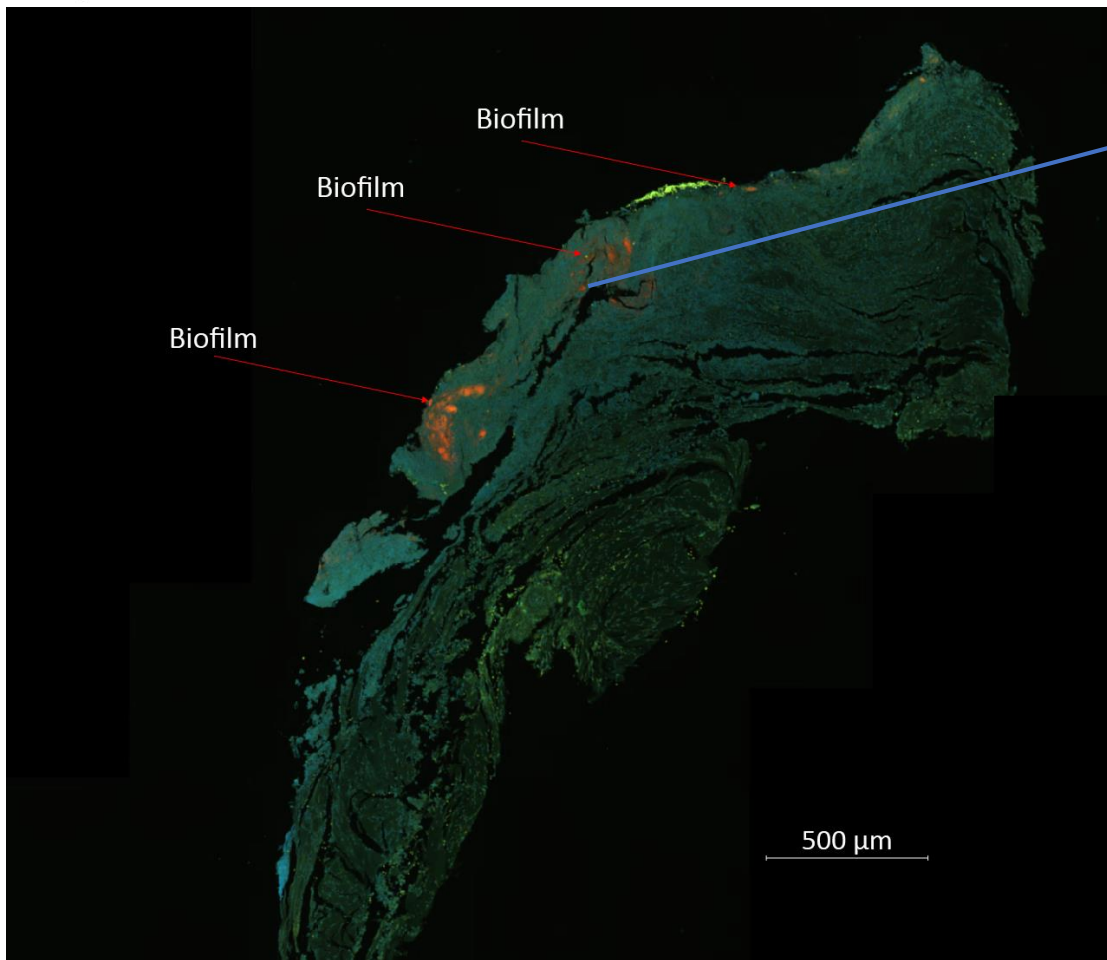
Pictures by Lasse Kvich

Sample 13 cut 2
Pa_TxR Unibac Flu



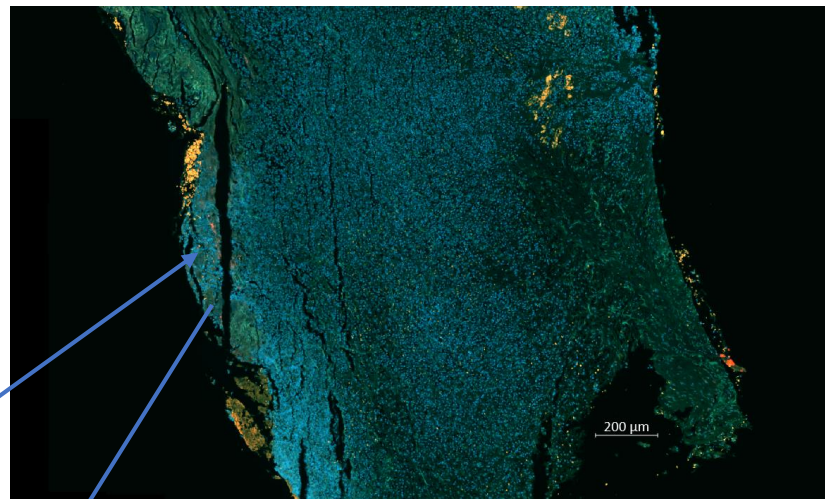
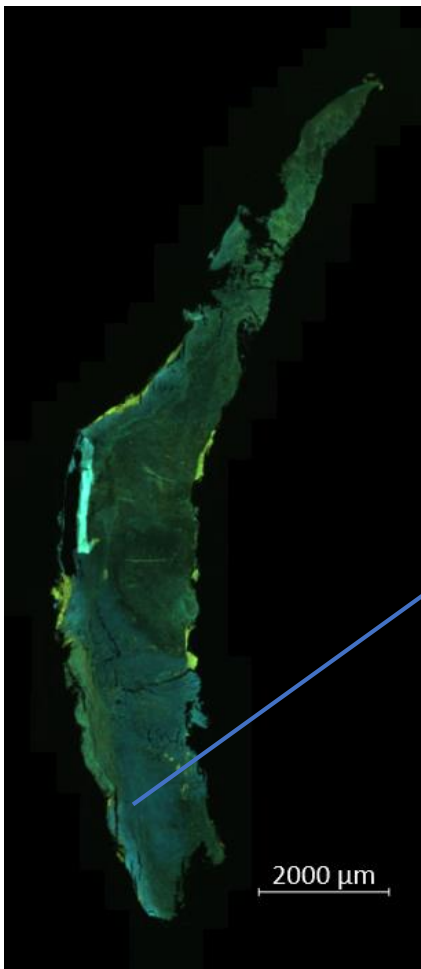
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Sample 13 cut 2
Pa_TxR Unibac Flu

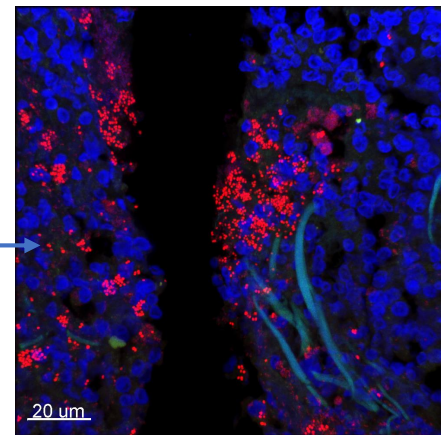
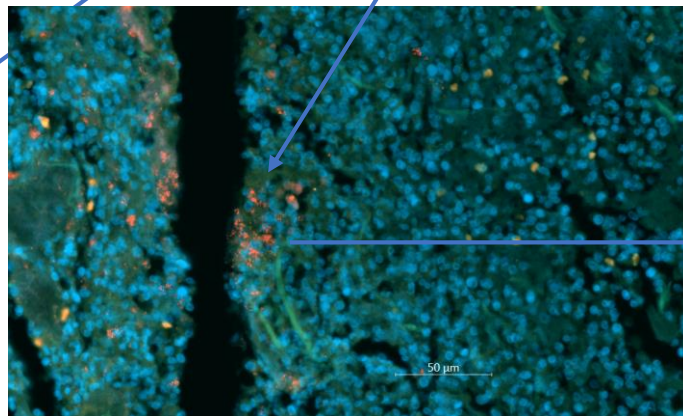


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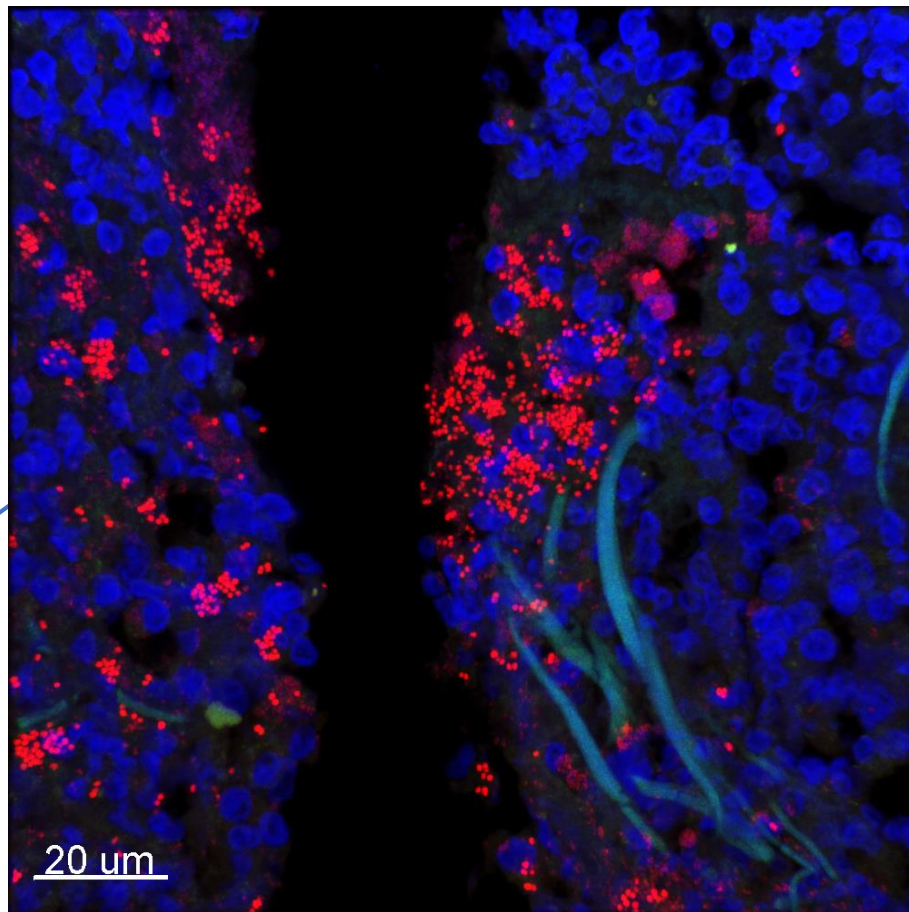
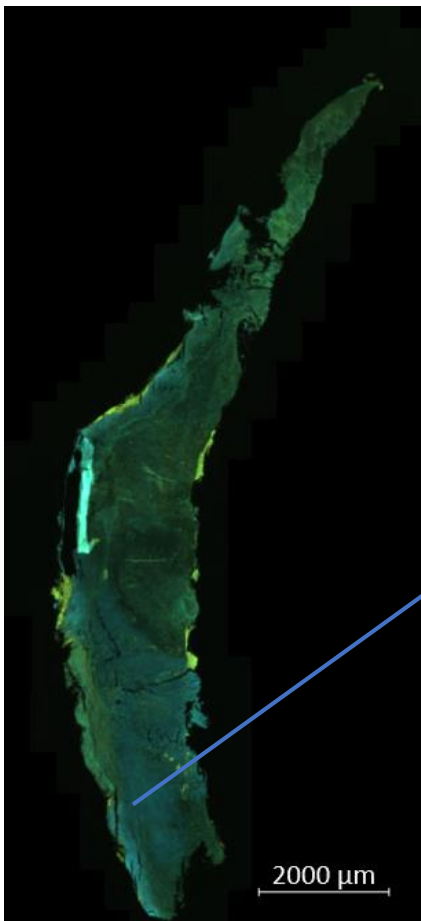
Sample 13 cut 2
Pa_TxR Unibac Flu



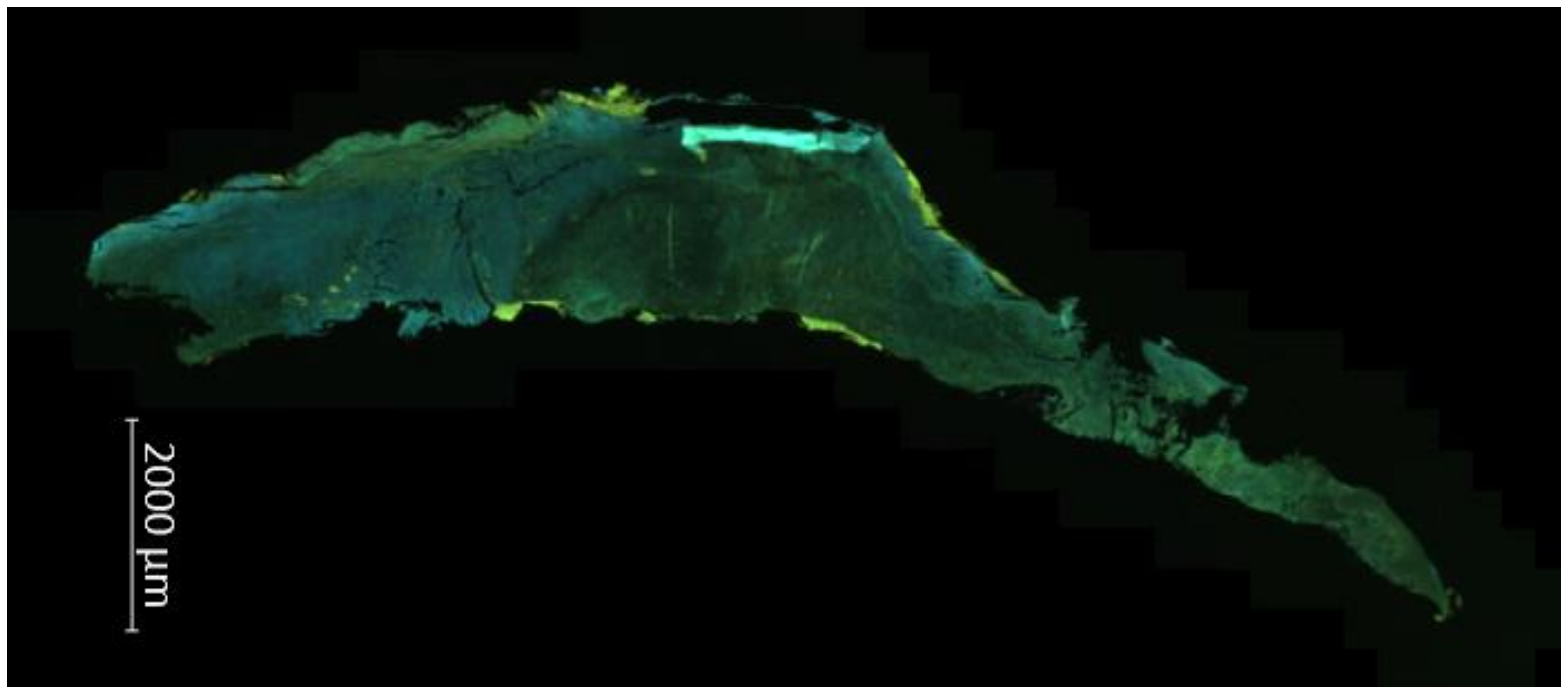
Pictures by Lasse Kvich

Sample 9 cut 1
Sa_TxR

Pictures by Lasse Kvich



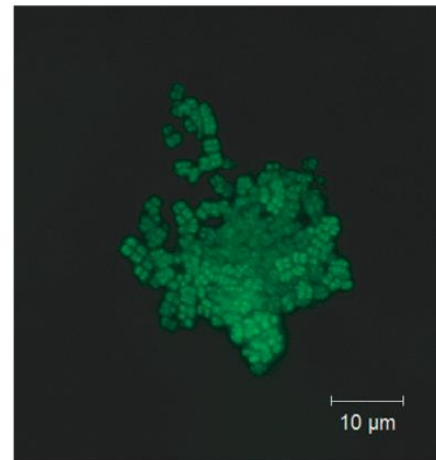
Sample 9 cut 1
Sa_TxR



Sample 9 cut 1
Sa_TxR

Vicious Biofilm?

- The biofilm (the extra-cellular matrix) is not harmful.
- The bacteria alter behaviour (pheno-type)
- The bacteria alter virulence
 - Controlled by
 - Quorum-sensing
 - Nutrients
 - Oxygen
 - Environment
 - Host
 - Other microorganisms



Window of Opportunity Dowd & Wolcott

- Disturbance of the biofilm forces the bacteria to re-adapt
- Wake-up the dormant cells
- Causes disturbance in the Quorum Sensing System
- Makes bacteria susceptible to antibiotics
- Makes bacteria accessible to immune defense system

Window of Opportunity Dowd & Wolcott

- Disturbance of the biofilm forces the bacteria to re-adapt
- Wakes-up the dormant cells
- Causes disturbance in the Quorum Sensing System
- Makes bacteria susceptible to antibiotics
- Makes bacteria accessible to immune defense system
- In theory!

Tools?

- Surgery
- Surgery
- **SURGERY**
- Surgery
- Surgery
- Repeated surgery



Antibiotics?



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Take Home Message

- How should we treat the biofilm?

- Off-loading
- Debridement
- Surgery
- Surgery should augment off-loading
- Change of dressing
- Antibiotics?
- Antiseptics? **Change the environment**

Thank you for your
attention

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